IFOY AWARD
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# Fully Automated Replenishment with Automated Guided Vehicles (AGV) in Production & Warehouse Logistics

**Application for IFOY Award 2017**
(Category 7)

# Automated Driverless Delivery (ADD) – Fully Automated Replenishment with AGVs

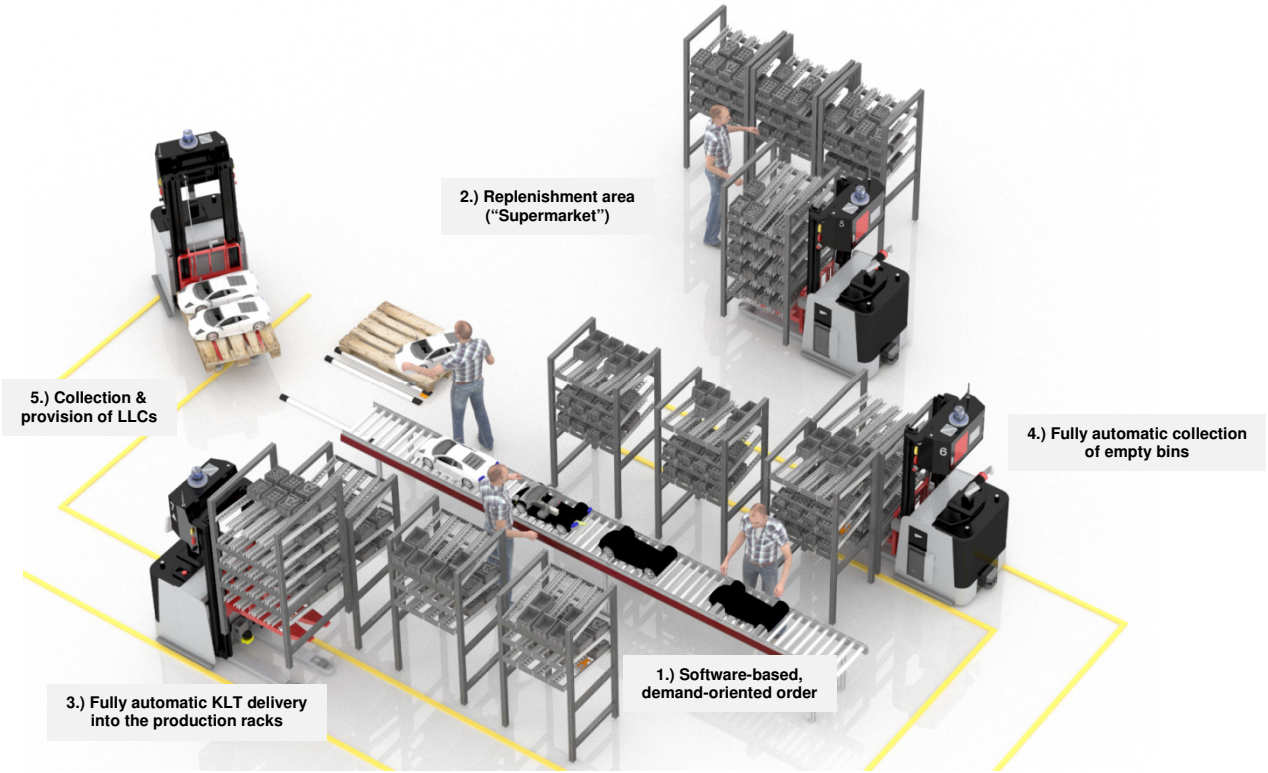
**With the innovative *Automated Driverless Delivery (ADD)* concept SSI Schaefer and its cooperation partner IDENTYTEC are setting new standards in the field of Intralogistics 4.0. The ADD system applied for the replenishment of small and large load carriers (SLCs/LLCs) in production and warehouse logistics operations is based on the proven technological components of automatic requirement notification systems and auto-ID products. These identification and retrieval systems have now been combined with automated guided vehicles (AGV) to form one of the most sophisticated, fully automated replenishment system. This newly developed, holistic system solution not only implements smart and highly transparent logistics processes with networked (sub)systems that intelligently interact with each other, but it also unleashes completely new opportunities with respect to flexibility while significantly reducing installation and operating costs.**

## Previous solution

Automatic material replenishment systems for production and assembly lines are currently controlled and administered through modular software working in conjunction with mobile terminals and electronic retrieval systems (eKanban). Within this solution, the main control system manages an automated process to retrieve all the materials needed for the production process. However, bulk goods are typically not managed using the defined parts lists and thus they are not incorporated into the automatic control system. To counter this problem, the channels of selected flow racks to the production work stations are specifically equipped with intelligent rocker switches that signal whether a storage location is filled or must be refilled. Furthermore, the current SLC stocks in the flow racks are visualised, allowing the system to automatically determine the locations where bins are currently available. As soon as the system detects that a minimum stock level of SLCs has been reached, an encrypted material replenishment order is triggered and radio transmitted wirelessly to the customer's ERP system. The replenishment material is then dispatched to the individual work stations via a manual tugger train solution. Refilling the flow racks is thus a rigid and inflexible "channel to channel" (large-scale) process, as individual channels cannot be targeted and refilled precisely and separately.

## Operating principle of the new system solution

The innovative ADD concept is a logical continuation of the integrated system approach of the existing solution. The level of automation and flexibility is significantly enhanced through the development of an integrated AGV solution combined with a transport and replenishment system that exactly operates at a SLC- and LLC-individual level. In this scenario, the AGV transports functional replenishment racks (or LLCs), carries bins of various sizes and independently navigates through the production site. Upon reaching the flow rack, the ADD quickly and accurately delivers only the required bins requested by the fully automated material retrieval signal via lifting mechanism to the respective channel. Subsequently, the bins are automatically conveyed straight to the correct channel of the production rack at the individual employee work station where the material is required. The typical ADD process therefore covers the entire process chain, from the fully automated retrieval of materials (material replenishment order) and replenishment delivery to the production rack, right through to the fully automated collection of empties. The ADD process is shown in the figure below (Note: ADD shown here, is exemplarily visualized with SLCs):




1.) Once the stock level on the rack for the respective production line reaches a predefined minimum level, an order is automatically generated by a software module (demand-oriented requirement notification). 2.) The replenishment order is triggered immediately and the replenishment rack on the AGV at the refilling station ("supermarket") is filled in the right sequence straightaway. An automatic put-to-light system supports the filling process in order to prevent errors, whereby the various bins are divided from each other on the mobile replenishment rack channel by electronically actuated separators. This separation particularly allows the SLCs to be filled into the respective production channels on an individual basis at their points of use. 3.) After the ADD has been filled in a sequential manner, the AGV transports the (mobile) replenishment rack to the production lines, which have been equipped with production flow racks. As soon as the AGV has manoeuvred itself to the correct location and the system has adopted the correct position through an integrated lifting device, the separators are actuated and the individual SLCs are released. The bins then rolls straight into the production rack under its own weight. The ADD carries a number of bins and controls different rack channels on an individual basis. As a main advantage, even the SLCs in the lowest level of the replenishment rack can be used to fill the highest level of the production rack using the lifting technology mentioned above. As a further technological development step it is planned to optimize the scalability of the system and lower the transport entity form bins to a single bin via a Mini-AGV to achieve the "transport lot size 1". 4) In a next step, the empty bins are fully automatic picked up from the production shelves via specific rack on the AGV. 5.) The stock levels of the LLCs at the working places of the production lines are also automatically controlled. When a predefined minimum/maximum level is reached, the goods on the LLCs are picked up and the respective locations will be supplied with replenishment.

## Advantages of the new system solution

In contrast to conventional and completely inflexible tugger train systems, which can also be used for regular, sequenced replenishment deliveries as per the Kanban principle, the ADD requires no human input (automatic delivery from the supermarket straight to the rack shelf) and thus optimises the entire logistical (delivery) process. The ADD forms a closed loop and integrated control cycle without media interruption and smooths out the complete delivery process by automatically linking warehouse locations in replenishment area, by fully automatic

handling of empty and full bins, by refilling the individual channels of the production area in a targeted manner, and by collecting the empties from the production racks where necessary. The ADD software monitors and controls the entire internal value chain, permitting quick adaptations to be made when qualitative and quantitative changes occur in the production process. Perfectly designed interfaces allow the software to be quickly and easily integrated into existing IT environments. Retrieval and delivery peaks at the start of a shift are thus eliminated while the number of tours made is significantly reduced by ensuring that only the material that is actually needed is transported to the production racks. Furthermore, the ADD prevents over- and under-deliveries of the individual work stations through its adoption of a lean production approach based on a Just-in-Time (JIT)/Just-in-Sequence (JIS) model, which means that the production racks are only supplied with the material needed at that specific time. This in turn results in greater speed and dynamism due to shorter response times. As only the minimum amount of stock is kept on the rack, the number of load carriers needed for production operations is significantly lower. Consequently, less capital is tied up through over-deliveries (low material stocks). A higher degree of utilisation is evident in ADD-based transports between the reserve area and production than can be seen with tugger train transports, which has a significant impact on solving the known problem of under/overcapacity on individual tugger trains. A smaller storage area is consequently needed at the production line (space-saving), meaning the available floor space can be used much more efficiently. In addition to the advantages already mentioned, the ADD reduces the risk of accidents and improves the ergonomics. It also has a strong impact on the entire layout of the production area, as far tighter curves and closer turning circles are now possible. Efficiencies gained by preventing human errors during picking are coupled with time-savings gained from employees no longer having to spend time searching for and scanning materials, not to mention the prevention of possible downtimes. Alongside the significantly lower expenditure required for the maintenance, servicing and repair of transport vehicles with the same – or even improved – level of reliability and security, the ADD concept also causes less wear to the production racks and their roller conveyors than conventional solutions.

In summary, the ADD is a fully automated, need-oriented, modular, scalable and, above all, a quicker and much more precise material replenishment system. It guarantees significant cost savings and a high degree of flexibility through the far more efficient use of resources. These qualities will undoubtedly see the ADD become an integral component of narrow Warehousing 4.0 and eKanban solutions in the intelligent factories of tomorrow.

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**Company profile**
The SSI Schaefer Group is the world's leading solutions provider of modular warehouse and logistics systems. The company employs over 8,500 people spread across its international headquarters in Neunkirchen, Germany, 60 foreign subsidiaries and at production sites within Germany and abroad. With a presence on six continents, SSI Schaefer develops innovative concepts and solutions in its customers' sectors to shape the very future of intralogistics.

## 2STACK® + ID.ADD –
## A process innovation for fully automated replenishment

In essence, the submission concerns an AGV-based ***process innovation*** in the field of intralogistics 4.0 that creates a closed loop and completely integrated control cycle and a fully transparent internal process chain conceptually incorporating novel technologies such as auto ID products and software-based eKanban. In response to the ever-increasing degree of individualisation in production and assembly, ***2Stack*** sets a new benchmark in intralogistics together with the intelligent ***ADD*** process by ensuring fully automatic, demand-driven and above all smaller-scale, faster and far more precise material replenishment via 2Stack compared to cost-intensive manual solutions or inflexible tugger trains.

2Stack, ADD and the software modules combine to create a functional overall system that will be ***piloted*** at ***VW*** as a real-time application. The business case to be implemented at VW will comprise a modified 2Stack vehicle, production shelves equipped with AUTO ID rockers for various levels and bins, as well as a station for the sequenced provision and filling of the electrified "driving shelves", which will be designed according to customer specifications. The application will be fully integrated in the existing IT infrastructure in real-time operations. Other new features of the solutions developed for the customer include the innovative control software for the AGV as well as direct power supply to the electrified replenishment shelves via 2Stack. In future extension phases, the number of target locations and 2Stack vehicles can be flexibly increased as desired.

In the replenishment application in the context of the integrated ADD process, 2Stack not only handles the transport of the replenishment and empty container shelves as well as the complete and above all fully automatic filling of the individual target locations but also charging of the buffer batteries of the control units in the shelf via purpose-designed contact points.

| **Technical Information** | | |
|---|---|---|
| Load Handling | Fork |  |
| Max. Payload | 1,500 kg | |
| Lift Height | Max. 4,000 mm | |
| Overall Length | 2,250 mm | |
| Overall Width | 980 mm | |
| Aisle Width for Euro-pallet | 2,800 mm | |
| Max. Travel Speed | 2.0 m/s | |
| Acceleration | 0.5 $m/s^2$ | |
| Travel Drive | AC 4 kW | |
| Battery | 24 V, AGM or 2Lite | |
| Guidance | Laser navigation | |
| Controls | MASS by MoTuM |  |